

Like arteries and veins that keep the body alive with a constant flow of blood, close to 26,000km of cables, more than 3,240km of gas pipelines and a 3,000-strong team of people work around the clock to keep Singapore's lights on and air cool. **Arti Mulchand** speaks to the unsung heroes.

Getting power to the people

IN 2004, when Mr Peter Leong oversaw the engineering division at Premas International, which provides property management services, Singapore was hit by one of its worst blackouts in history. Piped gas supply from Indonesia to Singapore's power stations was disrupted by a technical fault and most turbines were unable to switch to the backup source of fuel. It caused a two-hour outage affecting more than 300,000 homes.



POWERING LIVES

Building a more resilient grid

"I had to send our contractor up to carry him down. I saw how the residents were affected. Failure can be very serious and I know how important continuity is. I remember that even now," recalled the 57-year-old, who joined Singapore Power (SP) PowerGrid as general manager about five years ago.

THE power grid of the future could include a large number of distributed renewable generation sources such as solar photovoltaics, energy storage facilities and energy management systems. It is also expected to be flexible and scalable, such that fluctuations in energy demand or supply will not affect the grid's stability and reliability.

That image remains with him, and has served as a constant reminder in his current role as managing director of SP PowerGrid - he has to ensure "the lights are always on" for the company's 1.4 million customers.

But just like Singapore has evolved, so must the power super-highways. Mr Leong says that energy demand has increased dramatically between the pre-war period and now.

"Singapore is like a copper mine. There is 26,000km of copper underground because everything needs power. Just like blood needs to flow to every part of the body, electricity needs to flow to every corner of Singapore. And like the human heart, we cannot afford to fail, so we do everything we can and put every effort into ensuring nothing goes wrong."

Power is pumped through some 26,000km of cables to more than 10,000 transmission and distribution substations that convert electricity into the necessary voltages for various uses.

"The team works 24/7 to ensure the health of the system. We respond immediately to any system distress," Mr Leong said.

Temperatures of transformers are taken, insulating oil is checked, and other parameters are continuously measured - whether online or off - to ensure that



Mr Peter Leong, 57, managing director of SP PowerGrid, says that energy demand in Singapore has increased dramatically between the pre-war period and now. PHOTO: LIM YAOHUI FOR THE STRAITS TIMES

into how new technologies and energy sources, such as solar photovoltaic power, could impact the grid.

Mr Leong listed some of the major infrastructural projects in store for the nation - Changi Airport's Terminal 5, Project Jewel at Changi Airport, the redevelopment of the southern waterfront and new container ports at Tuas - his eyes lit up.

"We have to plan now for tomorrow," he said with a smile.

Mr Leong, who studied electrical engineering at RMIT University in Australia and did his master's at the National University of Singapore, began his career at the then-Singapore Institute of Standards and Industrial Research, which eventually merged with the National Productivity Board to become Spring Singapore.

There, he spent 18 years with safety on his mind, operating the nation's test lab for equipment and accessories that connected to the electricity network, then regulated by PUB, the national water agency.

He did product testing and also participated in investigations into electrical deaths.

When he moved on to Premas, he oversaw the maintenance and operation of equipment such as chillers, lifts and switchboards in commercial buildings and techno parks, and several town councils.

But it is at Singapore Power that he has found a "better sense of purpose", he said.

"I love being able to look at how to do things differently, and I can never say that my job is done. This is a journey without a finish line."

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Mr Thiam Chiong Seng helped build the Marina South substation, which powers Marina Bay Sands and Gardens by the Bay. ST PHOTO: NED XIMOBIN



Senior engineer Chu Xiao En (left) at SP PowerGrid's Emergency Operations Centre. PHOTO: LIM YAOHUI FOR THE STRAITS TIMES

POWER TRIP Lighting up Marina Bay

WHEN Mr Thiam Chiong Seng drives along the East Coast Parkway and past the Marina Bay area, it is rarely without a smile on his face.

The 47-year-old engineer is the director of network development at Singapore Power (SP), where he has worked for 16 years doing high-voltage equipment installations, including at the Marina South substation.

That means keeping the lights on in iconic buildings that include Marina Bay Sands, the Marina Bay Financial Centre and Gardens by the Bay.

"With Marina Bay, I know that we are literally powering it. You can see and feel the impact," he said. "That's why it's very exciting being in the energy business. You're not dealing with tiny electronics. What we build is so huge so you feel a real sense of satisfaction when you see a job completed."

SP's network development engineers develop and build the infrastructure that ensures continuous and reliable power supply to households, as well as industrial and commercial buildings. This includes forging the fit between network demand and supply, conducting simulations and doing tests and checks on equipment before it is used.

Usually, power has to be converted to 66kV before being reconvered to 22kV or lower voltages, but new equipment allows it to bypass that intermediate stage. That means saving on space and equipment cost.

The current capacity of the substation is 300 megavolt amperes (MVA) - meaning it can power up an area up to twice the size of Ang Mo Kio Town.

"But we have also future-proofed it so it can deal with the area's expansion," he explained, adding that the substation is capable of servicing the area's needs for at least the next decade.

The substation also has three sets of 230kV cables to create a situation of "double redundancy", so even if one set is knocked out, the other two function as

back-up, keeping the lights on. Mr Thiam got involved in the Marina South project in 2000, when his team helped outline the technical requirements for transmitting power through South-east Asia's first Common Services Tunnel, which was being built by the Urban Redevelopment Authority at the time.

Those tunnels, which sit between 2.5m and 20m underground, deliver everything from electricity to chilled water and telecommunication cables.

"The Government realised the CBD (Central Business District) had to be expanded, and we were able to support them in the development," said Mr Thiam, who oversees a department of 18, including six engineers.

Mr Thiam, who studied electrical and electronic engineering at Nanyang Technological University, started out in an industrial air-conditioning company before moving to substation maintenance work on 230kV transformers. He was so impressed with Singapore Power that he ended up applying for a job. He has not looked back since.

What he is especially proud of is that other countries look to Singapore for the types and technical specifications of equipment used and even quality control processes. But communicating this in-

formation can be harder than one can imagine.

"In China, it would be rude to speak English, but try finding the Chinese word for cross-linked polyethylene (XLPE) or polypropylene laminated paper (PPLP). Chinese is not our native language for technical terms," he exclaimed with a laugh, referring to the types of insulation materials used in cables.

His overseas exposure has also been eye-opening, not least because of the much higher tolerance level other countries have for disruptive electrical and road works.

"In China and India, they understand that electrical cabling is for the good of the country. Here? We have to work at night or traffic would be obstructed, and we can work only a limited number of hours at night because residents complain about the noise," he said, shaking his head.

"In other countries, they would just block off the road and finish it up in just months."

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Senior engineer Chu Xiao En (left) at SP PowerGrid's Emergency Operations Centre. PHOTO: LIM YAOHUI FOR THE STRAITS TIMES

MORE THAN DRAWING LINES

Planning for the next generation

ASK senior engineer Chu Xiao En what the biggest misconception about her job is and she will tell you it is this: "People think that planners only draw lines."

The 27-year-old works in Singapore Power's planning and strategy division, which plans for Singapore's electrical infrastructural needs five, 10 and even 20 years down the road.

They include the need for new substations, and the renewal or decommissioning of old ones.

"While the end result of a plan and review might be a line connecting two substations, a lot of analysis goes into exploring every possible option and anticipating all kinds of contingencies," she said.

The 15-strong team she belongs to gathers input from customers along Singapore Power's transmission and distribution grid, and looks at the growth and development plans for the country, said Ms Chu, who oversees network planning for Singapore's western region. She covers areas

such as Choa Chu Kang, Jurong, Woodlands and Ayer Rajah. Part of the job includes carrying out simulation studies, planning cable routes and substation sites, and figuring out how to get the best possible network at the lowest cost.

Each year, her department submits an updated five-year plan to the Energy Market Authority (EMA), which takes into account developments and changes.

"The EMA works top down and we work bottom up to forecast the national energy demand," she explained, adding that based on the latest estimates, energy demand in Singapore could grow between 2.2 per cent and 3.7 per cent each year between this year and 2023.

It is that kind of work that appeals to the self-confessed applied mathematics and physics fan.

"I have always been a rational and logical person so that's what attracted me to engineering. I like that one plus one will always be

two," said the Singapore Power scholar who did her degree in electrical engineering at Imperial College and her master's at Stanford University. She joined Singapore Power in 2009.

The job has multiple challenges. For instance, her department is looking into the renewal of a lot of electrical infrastructure that was created in the 1980s, but there are limitations on what can be done.

"Most of the renewals are done in mature estates, so you're working with a live network. You need to have a step-by-step contingency plan for anything that might go wrong," she explained.

The four years that Ms Chu has been at Singapore Power have included a three-month stint at the company's Melbourne-based subsidiary Jemena, and eight months in Network Management, a department tasked with ensuring that power supply to customers does not get disrupted.

She worked on, for instance, the diversion of power cables that

had been laid under Upper Bukit Timah Road to make way for the construction of Downtown Line 2, which is due to be completed in 2016.

"I never realised how much went into the planning of an MRT line. There is a lot of preparatory work that has to be done alongside the network. When these things happen, you are really trying your best to get things back up. I understand how challenging that can be."

And while being a planner also means gratification is much delayed, since most of the projects she has had a hand in planning have yet to become a reality, it makes the job no less fulfilling.

"We get to be involved first-hand in nation-building. And I appreciate that the good performance of our network today is the result of the work of some of my mentors and the planners that have come before me."

"Now, we're planning for the next generation."

ENSURING SMOOTH OPERATIONS

All fired up about keeping businesses cool

SINGAPORE District Cooling's (SDC) senior engineering officer for safety Arif Shah Mohd prouderly declares that in his seven years with the plant, there has not been a single serious accident.

The plant, which spans 19,000 sq m, supplies the chilled water that keeps many buildings in the Marina Bay financial district cool.

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"I have to cultivate a culture of safety among the staff as well as our contractors, and ensure that the plant has reliability and efficiency and operates safely. It can be tricky, and you have to be alert," said the 39-year-old, who holds a position more often held by someone who is trained in engineering.

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Mr Arif, an Institute of Technical Education graduate who studied mechanical and electrical drafting and design, toyed with the idea of becoming a policeman before ending up in IT support.

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Eventually, he learnt the ropes as an operations technician at a petrochemical plant on Jurong Island. That led him to a similar position at the SDC plant, which began operations in 2006. SDC is a joint venture between Singapore Power and Dalkia.

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Neither Keppel DHCS operations manager Wong Toon Soon (above) nor Singapore District Cooling senior engineering officer for safety Arif Shah Mohd (right) started their careers in the district cooling field, but both men now power vital aspects of their plants which provide cooling services in various parts of Singapore. ST PHOTOS: CAROLINE CHIA, NED XIMOBIN

1991, was also keenly interested in energy efficiency, which was a buzzword in the late 1990s.

He was introduced to the brand-new sector of district cooling when his company became involved in the construction of the Keppel DHCS plant in Changi Business Park, Singapore's first district cooling system, in 1998.

When completed, it would provide cooling services to businesses in the area, including commercial, banking, biomedical and water fabrication customers.

Mr Wong, who is now 51 and also a father of two, became an electrical foreman after completing a full-time Industrial Technician Certificate course at Singapore Technical Institute.

Fascinated, he applied for a position as senior control engineer in 2003. He said: "During the construction phase, I realised they were using the latest energy-efficient technologies and I was excited at the prospect of learning more. This was my opportunity."

Just three years later, he was promoted to operations manager of all three of Keppel's DHCS facilities. Keppel is the only other provider of district cooling services here, and services 18 customers in Changi Business Park and 18 at Biopolis. It also provides district cooling at Woodlands Water Fab Park.

At the moment, Mr Wong is planning to refresh the 13-year-old DHCS plant in Changi - Keppel's oldest DHCS facility - with new and more

working, ensures that the plants run smoothly, and works closely with Keppel's customers to help them maximise their efficiency gains.

He was involved in setting up a DHCS plant in the Sino-Singapore Tianjin Eco-City in 2010, where he oversaw everything from its construction all the way to the time the chilled water started pumping. It has been up and running since August.

At the moment, Mr Wong is planning to refresh the 13-year-old DHCS plant in Changi - Keppel's oldest DHCS facility - with new and more



efficient chiller equipment planned for next year. Keppel, which is looking into new sites for DHCS facilities,

most recently secured the contract to provide district cooling to Mediapolis from the second quarter of 2015.

Mr Wong is most encouraged by the growing footprint of district cooling, especially since building owners and tenants have

smaller carbon footprint. "It is better for business, and better for the planet as well," he concluded.

Chilled water is one of several utilities continuously pumped through a network of common services tunnels to 14 customers in the area, including Marina Bay Sands, the Marina Bay Financial Centre and One Raffles Quay.

CHILLING UNDERGROUND

The world's largest district cooling plant

ALL the action at what is arguably the world's largest district cooling plant by capacity is well hidden from public view. The plant is located five floors - about 25m - underground.

The only evidence of the plant's existence is a cleverly concealed cooling tower, which pops up above the ground facing Marina Bay Sands' hotel building.

A curtain of metal plates that allow exhaust heat to escape the tower shimmers in the sunlight, and a strategically placed water feature masks the sound of the water that flows from it.

Even access to the plant, which produces 600 tonnes of chilled water per hour, is like a scene out of Alice in Wonderland - there is no signage, only a small door located at the end of the Double Helix Bridge. Stairs and a lift transport the plant's 52 employees deeper underground.

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